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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/721,870	11/26/2003	Kengo Inoue	032136	6083
38834	7590	05/09/2005	EXAMINER	
WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP			EVERHART, CARIDAD	
1250 CONNECTICUT AVENUE, NW			ART UNIT	PAPER NUMBER
SUITE 700			2891	
WASHINGTON, DC 20036				

DATE MAILED: 05/09/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/721,870

Applicant(s)

INOUE ET AL.

Examiner

Caridad M. Everhart

Art Unit

2825

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 4-5-05.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-35 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 10-18 is/are allowed.
- 6) ☒ Claim(s) 1,3,7,9,19,20,23,24,26-29 and 31-35 is/are rejected.
- 7) ☒ Claim(s) 2,4,5,6,8,21,22,25 and 30 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

### Withdrawal of Finality

Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

### Response to Arguments

Applicant's arguments with respect to claims 1 and 9 and 7 have been found persuasive and new rejections follow below.

With respect to the Laxman et al reference, applicant has argued that the butylaminosilane compound used by Laxman et al did not result in carbon in the nitride. This argument has been persuasive with respect to claim 21.

Applicant has further argued that Laxman et al does not teach carbon-containing silicon nitride because the comparative examples are considered inferior by Laxman, et al. This argument is respectfully considered to be not persuasive because nonpreferred embodiments constitute prior art(MPEP 2123).

### ***Claim Rejections - 35 USC § 103***

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1 and 9 are <sup>\*</sup> rejected under 35 U.S.C. 103(a) as being unpatentable over Heo, et al. (US 2004/0171271A1) in view of Park, et al (US 2001/0041421A1).

Art Unit: 2891

Heo et al disclose forming a silicon nitride polishing stopper layer on a pad oxide layer(paragraph 0030, first line and paragraph 0032). A trench is formed by etching the layer and the substrate(paragraph 0032, first line). A liner of thermal silicon oxide is formed in the trench(paragraph 0035, first line), and an lpcvd layer of nitride is formed. The fill layer is a CVD oxide (paragraph 0043). The next step is a polish step, and the polish stop is then etched(paragraph 0044 and 0046).

Although Heo et al is silent with respect to plasma cvd, it is understood that the deposition method may be plasma CVD, since it is disclosed that the oxide may be HDP oxide(paragraph 0043), which is a plasma oxide.

Heo is silent with respect to the recited thickness of the silicon nitride layer.

Park et al discloses a silicon nitride liner and the conditions for choosing a thickness of the liner(paragraph 0046).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have determined the thickness of the silicon nitride layer to have been within the recited range because Park teaches that it is a variable of the art which it is within the ordinary skill in the art to determine.

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Heo et al in view of Park as applied to claim 1 above, and further in view of Vassiliev, et al. (US 6,180,490B1).

Heo et al in view of Park et al is silent with respect to the recited anneal temperature, although Heo et al discloses a densification step(paragraphs 0008 and 0009), which is

Art Unit: 2891

an anneal step. In addition, Park, et al teach a high- temperature anneal in order to densify the trench fill(paragreaphs 0047 and 00448).

Vassiliev, et al discloses that trench fill densification is performed at about 1050 degrees C. (col. 7, lines 7-10).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have performed the densification anneal in the process taught by Heo et al in view of Park et al at the temperature taught by Vassiliev, et al because Vassiliev et al teaches that this temperature is conventional for densification of trench fill.

Claims 19-21,23-29, and 31-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heo et al in view of Park, et al as applied to claim 1 above, and further in view of Laxman, et al. (US 5,874,368) and further in view of Liu, et al (US 6,590,271B2).

Heo et al in view of Park, et al is silent with respect to the silicon nitride containing carbon, and with respect to CMOS devices and the relative etch rates of the layers.

Laxman, et al discloses in Table I precursors for the deposition of silicon nitride. Because of the organic source material, carbon will be incorporated into the nitride, as taught by Laxman, et al. The temperature of formation includes the recited range(table 1).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have combined the nitride precursors known in the prior art as disclosed by Laxman et al with the process taught by Heo et al in view of Park et al because Heo et al teaches lpcvd nitride and Laxman et al teach lpcvd nitrides which are useful for

Art Unit: 2891

isolation liner layers . Further motivation for using the carbon containing liners is provided by Liu, et al, which teaches that carbon in the liner can be useful in some applications, which one of ordinary skill in the art would be able to determine.  
*(Cf) 4, lines 12-34)*

With respect to the p-channel or CMOS devices formed on the semiconductor substrate, these are conventional in the art and require isolation structures such as those taught by Heo, et al., so that it would have been obvious to one of ordinary skill in the art at the time of the invention to have formed p-channel devices and CMOS devices on the areas of the substrate separated by the isolation structures formed by Heo et al in view of Park et al and by Heo et al in view of Park et al Laxman et al and further in view of Liu et al .

With respect to the relative etch rates of the layers, since one of the layers is oxide and the other is nitride, it would have been clear to one of ordinary skill in the art at the time of the invention that the etch rates of the two layers are different with respect to etchants which one of ordinary skill in the art would be able to choose, as these etchants are well known in the art.

With respect to claim 34 and the requirement that the carbon-containing silicon nitride use a source gas of BTBAS, this is a product by process claim which is limited only by the product, and not by the process steps. Still, the combination of references includes the source gas of BTBAS taught by Laxman, et al, and the carbon added as taught by Liu, et al, so that there would result a layer formed from BTBAS which would have carbon added by the method taught by Liu, et al., so that the carbon-containing

Art Unit: 2891

silicon nitride layer could result either from the prior art precursors taught by Laxman, et al or by the combination of BTBAS and adding carbon as taught by Liu, et al.

***Allowable Subject Matter***

Claims 10-18 are allowed.

Claims 2,4,5,6,8,21,22,25, and 30 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The prior art of record does not teach the limitations with respect to the bias nor the magnitudes of the stress.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Caridad M. Everhart whose telephone number is 571-272-1892. The examiner can normally be reached on Monday through Fridays 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, B. Baumeister can be reached on 571-272-1722. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should

Application/Control Number: 10/721,870

Page 7

Art Unit: 2891

you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

C. Everhart  
5-2-2005

  
CARIDAD EVERHART  
PRIMARY EXAMINER